# Air Pollution History and Legislation

CE 524

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*Slides noted as AWMA are from: Understanding Air Quality from the Air and Waste Management Association*
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# What Causes Air Pollution Today?

Stationary or Point Sources

- Combustion of fuels for power and heat
- Other burning such as incineration or forest fires
- Industrial/commercial processes
- Solvents and aerosols

**Mobile Sources**

- Highway vehicles: cars, trucks, buses and motorcycles
- Off-highway vehicles such as aircraft, boats, locomotives, farm equipment, RVs, construction machinery and lawn mowers

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NEXT

# *Mobile Sources of Air Pollutants*

- Automobiles
- Diesel Trucks
- Buses
- Airplanes
- Trains
- Ships

Main Menu

# On-road

- Passenger vehicles
- Heavy trucks
- Motorcycles
- Motor homes
- buses

# Non-road

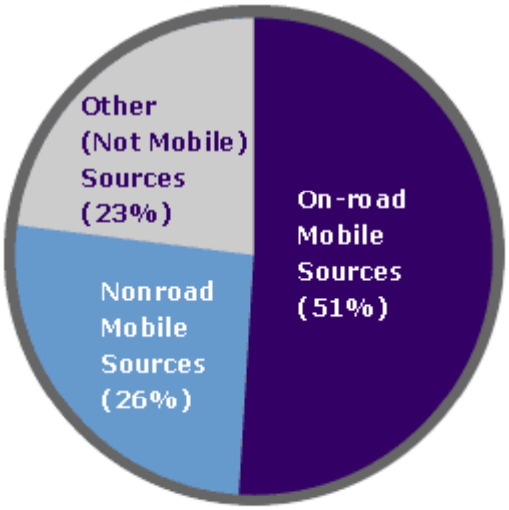
- Aircraft
- Marine
- Military
- Trains
- construction
- Small engine
  - Lawnmower
  - Snow blower
  - etc

*http://epa.gov/otaq/*

# Point Sources

- Include industrial and non-industrial stationary equipment or process that are a significant source of air pollution
- Boilers, turbine engines, wood processors, paper mills, refineries, etc

*Image: http://en.wikipedia.org/wiki/Air_pollution*

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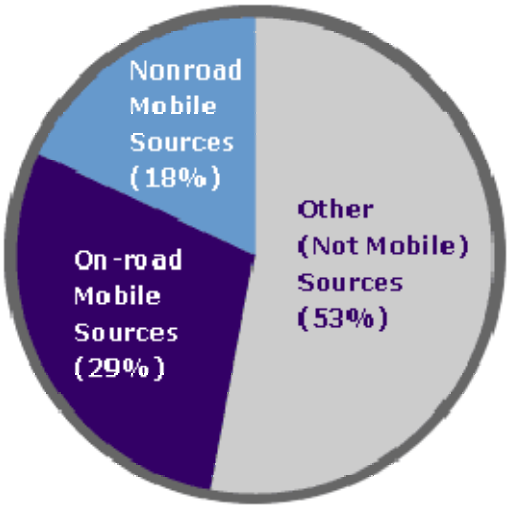


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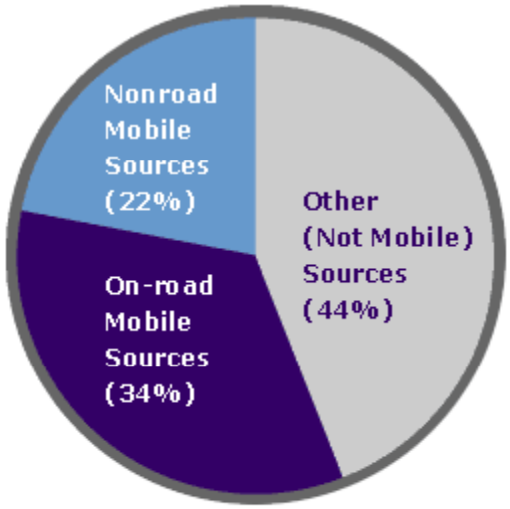


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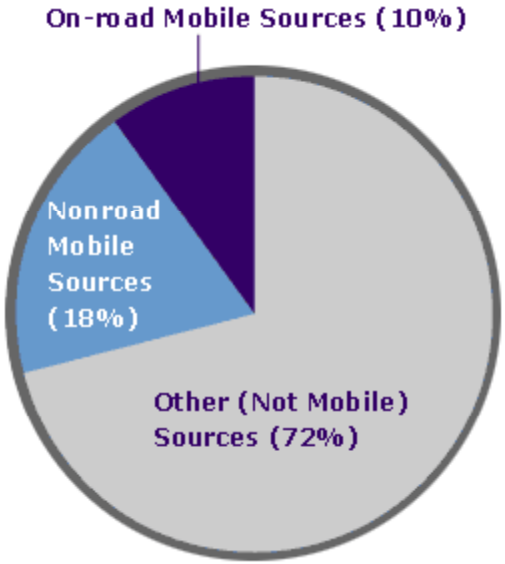



*PM2.5*

*Primary sources of air pollution*

# History of Air Pollution in the US

- Early history:
  - Disputes about unwanted ambient material resolved by common law nuisance
  - Gradually replaced by local ordinances
  - First Chicago and Cincinnati – 1881
  - 1920:  175 municipalities had air pollution ordinances
- 1940s early efforts to reduce air pollution
- First state effort (1947): CA, worsening conditions in the Los Angeles basin
  - Coined the term “smog”  (smoke & fog)

# History of Air Pollution in the US

- Air pollution episodes responsible for illness and death in several areas
  - Pittsburgh – 1948:  industrial emissions and temperature inverse created SO2
    - 20 deaths
    - Respiratory illness in half the population
- Ordinances began locally → state → national
- Major legislative and regulatory acts from 1955 to 1970

# Air Pollution Control Act of 1955

- First federally enacted legislation
- Considered air pollution control to be the primary responsibility of states
- But recognized that air pollution posed increasing dangers to the population
- Initiated
  - Research on effects of air pollution by the US Public Health Service
  - Provision for technical assistance to the states by federal gov.
  - Training of individuals in the area of air pollution
  - In-house and out-of-house research on air pollution control

# Air Pollution Control Act Amendments of 1960

- Worsening air pollution conditions
- Congress directed Surgeon General to conduct a thorough study of motor vehicle exhausts – effect on human health
- Study completed in 1962
- Required Surgeon General to conduct further studies on effect of motor vehicle exhaust

# Clean Air Act of 1963

- Provided federal financial aid for research and technical assistance
- Still did not specify how air pollution control should be divided among federal, state, and local governments
- Allowed federal jurisdiction over interstate commerce and interstate conflicts

# Clean Air Act of 1963

- Specifically provided for:
  - Acceleration in the research & training program
  - Matching grants to state and local agencies for air pollution regulatory control programs, with the federal government paying 2/3 to ¾ of the costs
  - Developing air quality criteria
  - Initiating efforts to control air pollution from all federal facilities
  - Federal authority to abate interstate air pollution
  - Encouraging efforts on the part of automotive companies and the fuel industries to prevent pollution

# The Clean Air Act

*Congress found:*

- Most people now live in urban areas
- Growth results in air pollution
- Air pollution endangers living things

*It decided:*

- Prevention and control at the source was appropriate
- Such efforts are the responsibility of states and local authorities
- Federal funds and leadership are essential for the development of effective programs

# Motor Vehicle Air Pollution Control Act of 1965

- Automobile cited for 50% of national air pollution problems
- Actually an amendment to the CAA
- Set national standards for automobile exhaust
- Applied current CA standards
  - HC
  - CO
- Disputed by automotive industry
  - But agreed to meet with 1968 model cars

# Air Quality Act of 1967

- Began attempt to set national standards for industries
- Did not succeed
- Provided for 2-year study on concept of national standards for stationary sources

# Provisions of the Air Quality Act of 1967

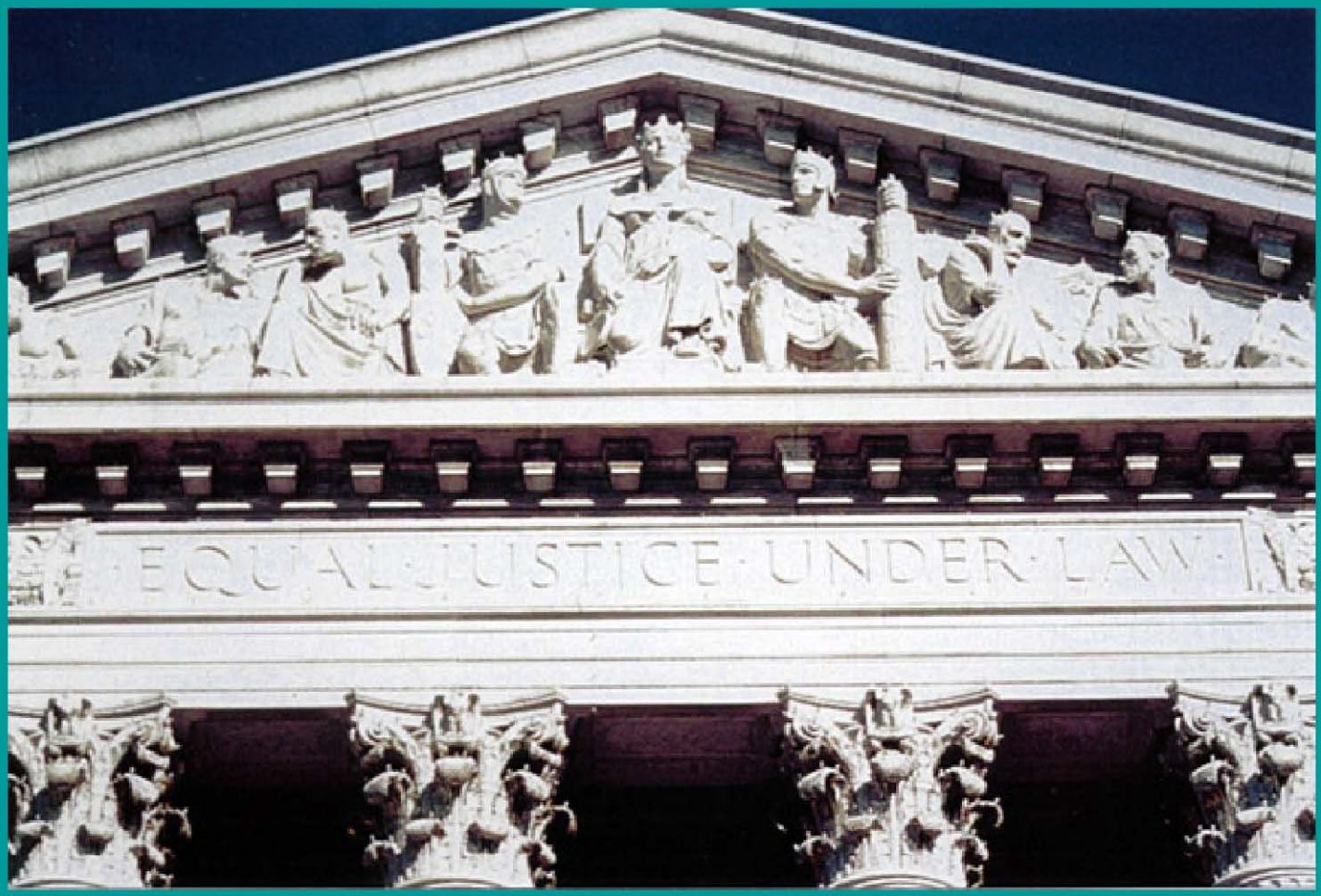
- Designated geographic air quality control regions
  - Meteorology
  - Topography
  - climate
- Developed air quality criteria for specific pollutants that had an identifiable effect on human health and welfare

# Provisions of the Air Quality Act of 1967

- Developed information on recommended air pollution control techniques
  - Could make recommendations on technology available
  - Joint initiatives between industry & gov to develop
- Required fixed schedule for state and local agencies to establish air quality standards consistent with air quality criteria
  - Otherwise set by feds

# Provisions of the Air Quality Act of 1967

- Provided $ for state motor vehicle inspection programs
- Allowed CA to set its own automobile emission standards




- The U.S. Environmental Protection Agency (EPA) was created in December 1970. While legislative efforts in air pollution control began prior to 1970, the landmark legislation which formed the basis for current air pollution regulations occurred with the passage of the Clean Air Act Amendments on December 31, 1970.

Main Menu

# Clean Air Act Amendments of 1970

- Air & water pollution major societal concerns
- All administrative functions for air pollution transferred to newly created EPA
- Intended to achieve clean air by 1975
- Regulation of
  - Criteria air pollutants
  - Hazardous air pollutants

# Major Provisions of 1970 CAAA

- Established NAAQS
  - Primary – allows adequate margin of safety to protect public health
  - Secondary – protects public from effects of air pollution
    - Plants, animals, visibility, public enjoyment of life & property
- Set new source performance standards for new stationary sources
- National Emission Standards for Hazardous Air Pollutants (NESHAPS) applied to existing and new plants
- Required states to submit *state implementation plans* (SIPs)
  - Method to set AQ standards for air quality regions within state

# Major Provisions of 1970 CAAA

- Provided for additional research funding for fuels at stationary sources
- Made additional state and regional grant programs
- Required SIPs to meet standards within 3 years
- Industry required to monitor and maintain emission records to be made available to EPA officials

# Major Provisions of 1970 CAAA

- Imposed fines and criminal penalties for violation of implementation plans
  - Known violation of standards
- Set auto standards:
  - CO & HC at 90% of 1970 levels
  - 90% $NO_x$ for 1971 model year
  - but Congress controls actual levels of performance
- Aircraft emission standards to be developed by EPA

# Major Provisions of 1970 CAAA

- Allowed states to set more stringent standards
- Permitted citizen suits
  - “against any person, including the US, alleged to be in violation of emission standards or an order issued by the administrator..”

# Criteria Air Pollutants

- Regulated to achieve National Ambient Air Quality Standards (NAAQS)
- Combination of standards
  - Existing sources (developed by state & local)
  - New sources (national standards)
- EPA set NAAQS

# Air Quality Criteria

- Based on levels to protect human health
  - Sensitive members of the population
- Developed based on relationship between exposure and short and long-term health and welfare effects
- Effects are expected to occur when pollutant levels exceed criteria for specified time period
  - Short-term -- immediate protection
  - Chronic exposure
- Pollutant levels cannot legally be exceeded during specific time period in a specific geographical area

# Clean Air Act Amendments of 1977

- Retained fundamental approach from 1970 CAAA
- Included new provisions requiring thorough review of ambient emission standards and alternative pollution control strategies
- By 1977 most areas still had not attained NAAQs
- Required to submit revision to SIP to demonstrate how attainment would be achieved

# Clean Air Act Amendments of 1977

- Set *new source performance standards* (NSPSs)
  - Defined max. allowable emission rates for 28 processes
  - New source: new source or a process that is modified in ways that increase potential to emit pollutants

# Clean Air Act Amendments of 1977

- Established new set of regions
- Recognized that air cleaner than NAAQS standards should not be degraded
- Removed incentive for industry to move from non-attainment to “clean” areas

# Air Quality Regions

- Redefined
- Class I:
  - Regions of pristine environment
  - Large national parks, wilderness areas, etc
  - Air quality can only deteriorate with consent of governor & fed. land manager

- Class II:
  - Industrial development allowed
  - Air quality changes only within set limits
- Class III:
  - Current industrial regions
  - Further development allowed if NAAQs not exceeded

# Clean Air Act Amendments of 1990

- Even with CAA and prior amendment
  - 96 cities still nonattainment for ozone
  - 41 cities for CO
  - 70 cities for $PM_{10}$
- Most significant changes since CAA
- 11 major divisions

# Criteria Air Pollutants

- 6 criteria pollutants
  - Carbon monoxide (CO)
  - Nitrogen dioxide ($NO_2$)
  - Sulfur dioxide ($SO_2$)
  - Total particulate matter (PM)
  - Hydrocarbons (HC)
  - Photochemical oxidants

# Violations

- 1 exceedance in a calendar year constitutes a violation – places area in non-attainment
  - For $SO_2$ and $NO_2$
- 2 excedance in calendar year constitutes a violation
  - 24-hr $PM_{10}$
  - 1 hr CO
  - 8 hr CO
- Based on consecutive 3-year period
  - 24-hr $PM_{10}$
  - ozone

# National Emission Standards

- Limit amount or concentration of pollutant emitted from a source
- Helps maintain or improve existing air quality in a region to meet state or local standards
- Based on what is achievable with current technology

# Basis for Regional Standards

- Availability of technology
- Presence of monitoring stations
- Ability to enforce standards
- Understanding of synergistic effects of different pollutants
- Preparation of diffusion model (predicting ambient concentrations)
- Accurate estimates of growth or decline in industry or population

# Emission Standards

- Visible emission standards
  - opacity of plumes
- Particulate concentration standards
  - Maximum allowable emission in mass/volume (i.e. grams/hour)
- Particulate process weight (mass) standards
  - Emissions per unit of material processed
  - Lbs per ton of product

# Emission Standards

- Gas concentration standards
  - For gas (volume/volume)
- Prohibition of emissions
  - Prohibition of open burning, fireplace, etc.
- Regulation of fuel
  - Amounts of contaminants allowed
  - Sulfur, lead
- Zoning restrictions
  - Limits facilities in areas by emission types
- Dispersion-based standards
  - Limits amount of pollutants based on concentrations contribution to ambient air quality

# *Title I*: Provisions for attainment and maintenance of NAASQ

- Classifies major urban areas by level of violation
- Defined stationary sources
  - Major source > 10 tons/yr of any pollutant or > 25 tons/yr of a combination of pollutants
  - Area source: not a major source
  - All sources need permits – renewed every 5 yrs.

# Nonattainment Areas

| Nonattainment Level | Years to achieve attainment |
|---|---|
| Marginal | 3 |
| Moderate | 6 |
| Serious | 9 |
| Severe | 15 |
| Extreme (LA) | 20 |

# *Title II*: Mobile Sources

- Motor vehicles
  - 50% Ozone precursors
    - VOC
    - NOx
  - 90% of CO
- Mobile source designations
  - Passenger vehicle
  - Truck

- Set standards for emission reduction – technology
- Requires reformulated gasoline (15% less VOC) in cities with worst $O_3$

# Title III: Air Toxics

- Regulation of 189 specific chemical
- Hazardous air pollutants
- Includes:
  - Industrial chemicals
  - Pesticides
  - Solvents
  - Metals
  - Combustion by-products
  - etc

# Title IV: Acid Rain

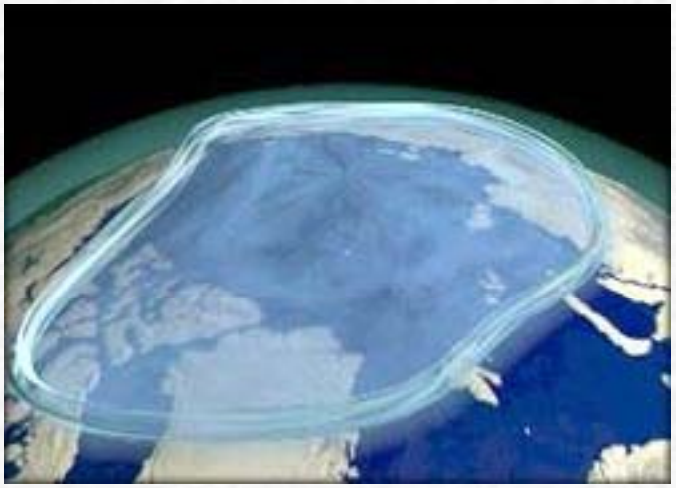
- Requires reduction of $NO_x$ and $SO_2$
- Requires reduction by sources
- Creates financial incentives
- Allows selling of “credits” if an industry performs better than expected

# Title V: Permits

- Requires operating permits of all current new sources of acid rain precursors and hazardous air pollutants
- Good up to 5 yrs
- Permits allow method to enforce, inspect, monitor, etc.
- Citizens as well as EPA are allowed to sue for non-compliance

# Title VI: Stratospheric Ozone and Climate Protection

- Reduces production of ozone destroying compounds
  - HC
  - CFC
  - Halons
  - Bans carbon tetrachloride after 2000
  - Methyl chloroform banned after 2002
  - Hydro fluorocarbons banned after 2030



# Title VII: Federal Enforcement

- Increases penalties for noncompliance
- Provision for citizens to seek penalties against violators

# 11 Titles in 1990 CAAA

- Title VIII: Miscellaneous Provisions
- *Title IX*: Clear air research
- *Title X*: Disadvantaged business concerns
- *Title XI*: Clean air employment transition assistance

# Post 1990 CAAA

- 1996: reviewed 1-h ozone standard (0.12 ppm)
  - Difficult to meet even with health effects
  - Decided to base on risk assessment
  - Replaced with 8-h standard of 0.07 ppm
- 1996: reviewed $PM_{10}$
  - Evidence that fine particulates posed health threat
  - Set $PM_{2.5}$ standards

# Air Pollution Control

- Clean Air Act of 1963 and amendments provides basis of air pollution laws in the US
- EPA prepares and publishes detailed regulations to show how laws should be applied
- Regulations are subject to:
  - Public hearings
  - Approval by the Office of Management & Budget
  - litigation
- Once regs have survived the above they have the force of law

# Air Pollution Regulations

- Published in the *Federal Register*
- Compiled in the *Code of Federal Regulations*, Chapter 40
- As of July 1997, air pollution regs – 7,261 pages
  - Include instructions on preparing SIPs for controlling air pollution within a state

# State Implementation Plans

- Must undergo public review and approval in state
- Reviewed and accepted (or modified) by EPA
- Included regulations for detailed operating permits for facilities
- Often includes direct fed. Regulations
- May include local regulations

# Permitting

- Required for any facility with potential
  - > 100 tons/yr of criteria pollutants
  - > 25 tons/yr of hazardous pollutants
- Potential:  emission resulting with no air pollution equipment
- A potential 100 ton/yr facility with 99% efficiency (actually only emits 1 ton/yr) still needs permit

# Permitting

- Nationwide products regulated directly by EPA
  - Vehicle  (CAFE standards)
  - fuel
- automobile emission inspection regulated by state or local
  - Influenced by federal regulations
- Not required for individuals
  - Regulated  locally
    - Open burning

# Current NAAQS

| Pollutant | Averaging Time | Primary Standard | Secondary Standard |
|---|---|---|---|
| **CO** | 8 hr | 9 ppm | Same |
| | 1 hr | 35 ppm | Same |
| **$NO_2$** | Annual average | 0.05 ppm | None |
| **$SO_2$** | Annual average | 0.03 ppm | None |
| | 24 hr | 0.14 ppm | None |
| | 3 hr | None | 0.5 ppm |
| **$PM_{10}$** | Annual arithmetic mean | 50 $\mu g/m^3$ | Same |
| | 24 hr | 150 $\mu g/m^3$ | Same |
| **$PM_{2.5}$** Added 1997 | Annual arithmetic mean | 15 $\mu g/m^3$ | Same |
| | 24 hr | 150 $\mu g/m^3$ | Same |
| **Ozone** | 1 hr | 0.12 ppm | Same |
| | 8 hr | 0.08 ppm | Same |
| **Lead** | 3 months | 1.5 $\mu g/m^3$ | same |

# Visibility

- Although not a pollutant, visibility is a major pollution concern
- Haze
- Smog

# New Standards

- 8-hour ozone (2007)
- 24-hour Ozone
- New fuel standards—35 mph

*http://www.epa.gov/air/particlepollution/standards.html*

## National Ambient Air Quality Standards

| Pollutant | Primary Stds. | Averaging Times | Secondary Stds. |
|---|---|---|---|
| Carbon Monoxide | 9 ppm (10 $mg/m^3$) | 8-hour[(1)] | None |
| | 35 ppm (40 $mg/m^3$) | 1-hour[(1)] | None |
| Lead | 1.5 $\mu g/m^3$ | Quarterly Average | Same as Primary |
| Nitrogen Dioxide | 0.053 ppm (100 $\mu g/m^3$) | Annual (Arithmetic Mean) | Same as Primary |
| Particulate Matter ($PM_{10}$) | Revoked[(2)] | Annual[(2)] (Arith. Mean) | Revoked[(2)] |
| | 150 $\mu g/m^3$ | 24-hour[(3)] | Same as Primary |
| Particulate Matter ($PM_{2.5}$) | 15.0 $\mu g/m^3$ | Annual[(4)] (Arith. Mean) | Same as Primary |
| | 35 $\mu g/m^3$ | 24-hour[(5)] | Same as Primary |
| Ozone | 0.08 ppm | 8-hour[(6)] | Same as Primary |
| | 0.12 ppm | 1-hour[(7)] (Applies only in limited areas) | Same as Primary |
| Sulfur Oxides | 0.03 ppm | Annual (Arith. Mean) | ------- |
| | 0.14 ppm | 24-hour[(1)] | ------- |
| | ------- | 3-hour[(1)] | 0.5 ppm (1300 $\mu g/m^3$) |